They were apparently obtained with samples whose thicknesses did not correspond to the striker thickness, and consequently, the parameters of the shock wave in the graphite were distorted by the relaxation waves.

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NOISE LIMITATIONS ON THE RECONSTRUCTION OF THREE-DIMENSIONAL PICTURES

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Submitted 14 June 1966
ZhETF Pis'ma 4, No. 5, 172-174, 1 September 1966

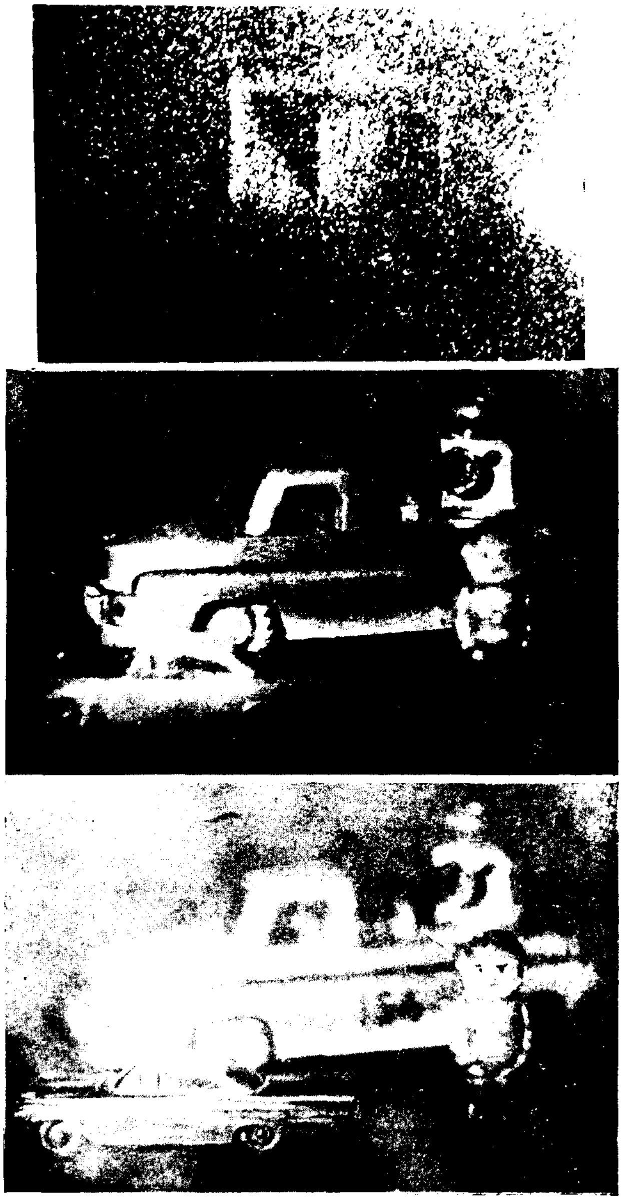
Holography methods make it possible to obtain three-dimensional pictures having a high resolution and a large dynamic brightness range [1-4]. However, the realization of these advantages is hindered by the presence of noise, which comes into play during the reconstruction of the image in a manner entirely different from ordinary photography.

Indeed, since the emulsion is not a continuous medium, but a system of randomly disposed grains separated by appreciable distances (compared with the wavelength λ), the interference pattern registered on the hologram has discontinuities. When coherent light is transmitted through such a hologram, the discontinuities become sources of scattered radiation, whose distribution in space obeys laws that are characteristic of shot noise.

The final formula characterizing the ratio of the useful signal power to the power of the background produced by scattering from these inhomogeneities is

$$P_s/P_n = n_0\lambda^2 \frac{R^2}{S_{ob}} \frac{f'^2(W_h)}{f(W_h)} \frac{S_{eff}}{S_h},$$

where n_0 is the density of the emulsion grains, R the distance from the hologram to the diffused object of the photography, S_{ob} the area of the object, $f(W_h)$ the dependence of the fraction of the developed emulsion grains on the light energy, S_h the total area of the hologram, and S_{eff} the area of the section of the hologram on which the interference pattern corresponding to the given image element is resolved by the emulsion.



The derivation of this formula is based on the fact that the useful signal is the result of coherent addition of waves that start from different elements of the hologram, and the background is the result of addition of waves scattered by individual emulsion grains, with random phases.

For $\lambda = 0.63\ \mu$, $R = 3$ cm, $S_{ob} = 10$ cm^2, and $n_0 \approx 10^7$, we obtain $P_s/P_n = 6$, and for better emulsions ($n_0 \approx 10^8 - 10^9$) we obtain $P_s/P_n \approx 60 - 600$ which is 2 - 3 orders of magnitude smaller than indicated in the literature [2-4]. To confirm these estimates, we experimented with production of holograms and reconstruction of three-dimensional images on different emulsions. The holograms were taken with a single-mode gas laser of ~2.5 MW power; the exposures were several minutes and the hologram dimensions 9 x 12 cm. To reconstruct the images we used an LG-75 laser operating in the multimode regime at a power 20 - 25 MW.

The figure shows photographs of the imaginary pictures. The upper picture corresponds to an emulsion with $n_0 = 10^7$ (the object of the photography was an emblem); the lower photographs were obtained with better grade emulsions. One can see that the quality of the image is greatly improved. The values of P_s/P_n determined by photometry of the images were found to be close to the calculated values for these cases.

Inasmuch as the observed picture was three-dimensional (10 x 10 x 15 cm), it was impossible to focus simultaneously all the objects on the plane photographs shown here. The two lower photographs correspond to focusing on different parts of the picture.

The calculations and the experiments show that the graininess of the emulsion influences not only the resolving power of the image, but also more importantly, the level of the background that distorts the brightness distribution in the image.

The authors thank I. R. Protas and G. P. Feierman who supplied the photographic plates with which the best three-dimensional images were obtained, and also Yu. G. Turkov, I. V. Potapov, and L. N. Razumov for great help with the experimental research.

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REST MASS OF MUONIC NEUTRINO AND COSMOLOGY

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Submitted 4 June 1966
ZhETF Pis'ma 4, No. 5, 174-177, 1 September 1966

Low-accuracy experimental estimates of the rest mass of the neutrino [1] yield $m(\nu_e) < 200$ eV/c^2 for the electronic neutrino and $m(\nu_\mu) < 2.5 \times 10^6$ eV/c^2 for the muonic neutrino.

Cosmological considerations connected with the hot model of the Universe [2] make it possible to strengthen greatly the second inequality. Just as in the paper by Ya. B. Zel'dovich and Ya. A. Smorodinskii [3], let us consider the gravitational effect of the neutrinos on the dynamics of the expanding Universe. The age of the known astronomical objects is not smaller than 5×10^9 years, and Hubble's constant H is not smaller than 75 km/sec-Mparsec $= (13 \times 10^9 \text{ years})^{-1}$. It follows therefore that the density of all types of matter in the Universe is at the present time 1)

$$\rho < 2 \times 10^{-28} \text{ g/cm}^3.$$

The space surrounding us is filled presently with equilibrium radiation of temperature 3°K [4]. It is proposed that this is "relict" radiation and is proof of the high temperature possessed by the plasma during the pre-stellar high-density period.

At a temperature of the order of 3 MeV for ν_e and of the order of 15 MeV for ν_μ, complete thermodynamic equilibrium existed between ν, γ, e^+, and e^-. The number of other particles in this equilibrium is small, except perhaps gravitons, which, however, have no effect on the arguments that follow. In thermodynamic equilibrium, the ratio of the number of fermions and antifermions with spin 1/2 to the number of quanta is

$$[\nu_e] + [\bar{\nu}_e] = [\nu_\mu] + [\bar{\nu}_\mu] = [e^+] + [e^-] = 2\frac{\int(e^x + 1)^{-1}x^2dx}{\int(e^x - 1)^{-1}x^2dx}[\gamma] = 1.5[\gamma].$$

However, during the course of the cooling from $T > m_ec^2$ (for which these relations are written) to the present time, when $T \ll m_ec^2$, these relations change, since the annihilation